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CMWR 2008 STUDENT FELLOW AWARDEE

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TITLE: Two Dimensional Upscaling of Pressure and Permeability for Relative Permeability and Mass Transfer Terms in a Two Phase Flow System.

ABSTRACT

Computational models and appropriate upscaling techniques are important for proper mathematical description and subsequent computational simulation of two-phase transport in porous media. This includes important applications associated with modeling the fate and transport of CO2 injected into deep saline aquifers for the purpose of atmospheric emission avoidance, which is likely to be part of large-scale carbon capture and storage (CCS) strategies. In the current study a, semi-implicit model over an unstructured grid is used to simulate CO2 injection into a heterogeneous saline aquifer. The model accounts for three components (CO2, Water and Salt) two mobile fluid phases (Brine and CO2) and a static solid phase (Salt due to precipitation). To validate the model several runs were compared with TOUGH2's ECO2N module. The model is used to upscale capillary pressure and relative permeability constitutive functions, incorporating the modified definitions of average pressure introduced by Nordbotten et al. (2007). We also propose an algorithm to upscale mass transfer between the brine and CO2 that builds on concepts of percolation theory to estimate the sub-grid-scale saturation distribution. These results can be applied to simplified models of the CO2-brine system that apply over very large spatial scales, characteristic of the size of the entire Alberta Basin. Such basin-wide models may be necessary to properly account for the subsurface impacts of a CCS strategy at full-scale implementation.